THE EFFECT OF JUVENILITY ON ROOTING OF CUTTINGS FROM APPLE SEEDLINGS

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IT HAS LONG BEEN KNOWN that cuttings from young seedlings can be rooted much more readily than can cuttings from mature trees. Extensive tests conducted by Gardner (1929) with seedlings of apple, pear, cherry, elm, locust, pine and spruce showed that cuttings from one-year-old seedlings rooted easily. He obtained some rooting from cuttings from two-year-old seedlings, but as the seedlings grew older it was difficult or impossible to root the cuttings taken from the upper branches.

It also has long been known that the basal part of the tree remains in the juvenile stage. More than 150 years ago Thomas Andrew Knight observed that shoots from the base of a seedling pear tree possessed juvenile characters and that scions from such shoots, when grafted on pear rootstocks, were much slower to come into fruit than scions from the bearing branches.

It is also known that cuttings taken from the lower branches of seedling trees will root more easily than cuttings taken from the tops of the mature trees (Grace, 1939; O'Rourke, 1951). The basal part of the tree appears to remain in the juvenile stage and a seedling tree can be kept in the juvenile stage indefinitely by cutting it back to the ground each year (Blair, 1955).

These observations on the relation of juvenility to ease of rooting of cuttings are of considerable significance in the clonal propagation of trees and shrubs. Clonal propagation of certain species by cuttings is essential to maintain a uniform root system. It is also essential in species such as the lilac, which suckers from the roots, if the clone is to be maintained true to type by the amateur horticulturist.

Seedling trees can be grown to maturity so that the flowers and fruits can be evaluated, but can still be propagated readily by cuttings by forcing sucker shoots from the base of the trunk. This can be done by girdling the bark near the base of the trunk or cutting the tree back nearly to the level of the ground. Less drastic methods are bark inversion or "scoring" the bark of the trunk near the base of the tree.

Tests were made on four-year-old seedlings of an ornamental apple, *Malus* 'Henry F. duPont,' grown in the Bussey Institution nursery during the summer of 1958. In June 1957 every other tree in the nursery row had a short ring of bark inverted to induce earlier flowering. The bark-inverted trees did not fruit earlier than the controls, but they did produce profuse suckering from the base of the tree. In some cases the sucker shoots bore leaves which were tri-lobed, even though the mature branches bore only entire leaves. In other cases there was little morphological difference be-

tween the juvenile and adult leaves. All of the trees tested fruited for the first time in 1958.

Cuttings from sucker shoots and from fruiting branches were taken in June. The cuttings, which were about eight inches long, were cut in half to provide basal and tip cuttings. Half of the cuttings were treated with Hormodin No. 2, while the other half were planted with no hormone treatment. The cuttings were set in wet sand in greenhouse flats, a wire frame was placed over them, and the entire flat and wire frame were enclosed in polyethylene film. The enclosed flats were set in the shade under the greenhouse bench and given no further attention until examined for rooting. The results are shown in TABLE I.

The juvenile cuttings of tree number 16155–4 rooted rather well with or without hormone treatment, but the adult cuttings rooted poorly or only moderately well, even with hormone, and very poorly, or not at all, without hormone. The juvenile cuttings of tree 16155–14 also rooted much better and earlier than did the adult cuttings. With tree 16155–21 the adult basal cuttings rooted comparatively well with hormone. In general the basal cuttings of either juvenile or adult branches rooted better than the terminal cuttings and the juvenile cuttings from the basal suckers rooted much better than the adult cuttings from fruiting branches. The cuttings which

TABLE I. **Rooting of Cuttings from Juvenile and Mature Branches**

TREE NUMBER	TYPE OF CUTTINGS	HORMONE	NUMBER OF CUTTINGS	PER CENT ROOTED AFTER WEEKS 2	3	4	5	6
16155–4	J,T*	+	10	40		40	50	
"	J,T	–	10			40		50
"	J,B	+	10	80		90	90	
"	J,B	–	10			80		80
"	A,T	+	10	20		20	20	
"	A,T	–	10			0		0
"	A,B	+	10	0		50	50	
"	A,B	–	10			0		10
16155–14	J,T	+	8	75	87		100	
"	J,T	–	10			20		30
"	J,B	+	8	87	87		100	
"	J,B	–	10			100		100
"	A,T	+	8	0	0		0	
"	A,T	–	10			0		10
"	A,B	+	8	0	12		62	
"	A,B	–	10			20		40
16155–21	J,T	+	9	0	33		77	
"	J,B	+	9	11	77		77	
"	A,T	+	9	0	0		22	44
"	A,B	+	9	0	44		77	

* A = Adult; J = Juvenile; T = Terminal; B = Basal.

rooted in two weeks were more likely to thrive when transplanted than those which required a longer time.

Cuttings from root suckers were also found to root more easily than cuttings from mature fruiting branches, even when the root suckers had developed six or seven feet from the base of the tree. Suckers from the roots were numerous on a *Malus sargentii* f. *rosea* hybrid (3340) which was 18 years old and growing in sod. Cuttings were made in the same manner as previously described. The results are shown in TABLE II. No rooting was obtained from the cuttings from the fruiting branches, but moderate rooting, with hormone, was produced in four weeks by cuttings from the root suckers. Evidently the roots retain their juvenility for a greater distance from the base of the tree than do the branches.

In the summer of 1957 Dr. Karl Sax found a seedling of Hopa Crab (*Malus baccata* × *pumila niedzwetzkyana*) which appeared to be promising as a dwarfing rootstock because of its thick bark — a characteristic of the extremely dwarfing rootstock varieties used in Europe. Cuttings from the original three-year-old seedling gave 91 per cent rooting in two weeks, and cuttings from lateral branches of the Hopa Crab seedling budded on *M. sargentii* f. *rosea* gave 100 per cent rooting in two weeks, using hormone (TABLE II). Even without hormone 85 per cent rooted in four weeks. These rooted cuttings were transplanted to soil, with no loss, for testing as a dwarfing rootstock and to see if they can be kept as permanent juveniles (as a source of cuttings) by keeping them cut back to the ground level each year.

TABLE II. **Rooting of Cuttings from Juvenile and Adult Seedlings**

TREE NUMBER	TYPE OF CUTTING	HORMONE	NUMBER OF CUTTINGS	PER CENT ROOTED AFTER WEEKS 2	3	4	5	6
33340	A.T.*	+	25	0		0		
"	A.T.	−	25	0		0		
"	R.T.	+	15	13		53		
Hopa Sdlg.	T	+	12	91				
"	S	+	12	100				
"	S	−	20	40		85		

* A.T. = Adult Terminal; R = Root sucker; T = Terminal; S = Secondary.

SUMMARY

Juvenile shoots from the base of fruiting seedling apple trees, induced by bark inversion, were found to root more readily than cuttings taken from the fruiting branches. Root suckers of a mature apple tree rooted well, although cuttings from the fruiting branches produced no roots, even with hormone treatment. A three-year-old seedling of Hopa Crab rooted very readily from cuttings to be tested as a dwarfing rootstock clone. The production and retention of juvenility in clonal varieties of trees and shrubs should be of value in clonal propagation.

This work was supported, in part, by a grant from the Massachusetts Society for Promoting Agriculture to Dr. Karl Sax.

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